A New Scientific Challenge in Economics: Theory Building via Synthesis

Bal, F.; Nijkamp, P.

1998

SERIE RESEARCH MEMORANDA

A New Scientific Challenge in Economics: Theory Building via Synthesis

Frans Bal
Peter Nijkamp

Research Memorandum 1998-56

vrije Universiteit *amsterdam*

A New Scientific Challenge in Economics: Theory Building via Synthesis

30 September 1998

Frans Bal Peter Nij kamp

Faculty of Economics
Free University of Amsterdam
MASTER-Point
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

Abstract

Since the Cartesian era emphasis within theory building has been upon analysis. However, increasing numbers of case studies have revealed drawbacks in theory building via an analysis approach, one of which is a somewhat narrow focus. Another weakness of this approach is that an analysis is a focus on a subset of elements and relationships which describes the phenomena under study. As a result, the theories obtained are largely conditional in character. Normally, ***only*** through the use of the ***ceteris*** *paribus* clause can the theories be maintained. Third, often a repetition of studies can be observed. However, these repetitive studies often show mutually conflicting outcomes. Only an integrated study seems able to deal with these problems. Yet, another obstacle. can be observed in scientific research: within the social sciences field, and particularly in economics, it is problematic to undertake large-scale or detailed studies based on controlled repetition, and therefore only a small set of studies is available for theorizing purposes. Because there are difficulties inherent in the standard analytical method, we propose in this paper a synthesis approach, or more precisely, the use of meta-analysis as a tool for more accurate theory building in the field of economics. We present an overview of the current state-of-the-art as well as the features of meta-analysis.

1. Introduction

Ever since the work of Descartes, Spinoza and Kant, empirical scientific research endeavors have focused on the analytical study of real world phenomena to reach a better understanding of the underlying principles that lead to their appearance. This process focuses on a particular subset of moderator variables, and the measurement of their mutual relationships is still the foundation of knowledge accumulation and scientific theory building. However, a trend towards more holistic study approaches can be observed, as may be seen in the study of complex systems. Simultaneously, a movement to integrate multiple research findings is also underway. There are several reasons for studying previously undertaken research in a broader perspective. First, over the years, in scientific research a huge number of studies have become available on a rich variety of subjects. For example, the valuation of recreational sites in the USA (see Parsons and Kealy, 1994; Dwyer et al., 1977) and in Europe (see Bos and Van den Bergh, 1998; Bateman et al., 1995) has yielded a large body of studies. But in many other fields of economic research, such as labour market economics, environmental economics and public finance, a wide range of case studies concerning many issues are presently available. In scientific research the objective is to build a theory upon the set of case studies with the aim that it will also be valid in cases other than the studied/explored ones. Hence, in empirical studies argumentation based on induction leads to a theory.

As more studies become available concerning a certain phenomenon, more knowledge can be included in the theory building process. However, repetition among studies is a noteworthy problem. At first glance a repetition of studies suggests that much of scientific research is inefficient. However, according to Bal and Nijkamp (1998a), since most of the studies are to some degree unique in character - they differ in time, the geographical characteristics, the period in time considered, the methods applied, the assumptions used, etc. - they contain useful information. However, the richness of available knowledge is problematic when the sources leading to these differences among research findings cannot be traced, such as the inconsistencies among the research findings of repetitive studies. Theorizing is troublesome in this situation.

Besides the problem of inconsistencies among research findings another problem may exist in a theorizing process. Despite the great volume of published study findings in general, in social sciences some fields of research face significant impediments with regard to initiated research initiatives. Several factors may be accounted for this. For example, the initiation of case studies may be expensive or impossible. Clearly, a small set or an empty set of available studies will hamper theory building in this respect. Thus far, this problem has been eased somewhat by the use of assumptions and artificial theoretical models in order to make an argumentation possible for creating a basis for theorizing. As a consequence, we must rely on self-contained knowledge when assumptions and theoretical models are used. For example, there is no guarantee that the outcome is empirically valid. Therefore, further exploration of the small set of case studies might be of great value in order to accumulate knowledge which could be used for theorizing.

Thus far, the exploration of small sets of case studies, the investigation of inconsistencies among research findings, and the test of the reliability of study outcomes from artificial argumentation processes has been practically impossible. In fact, the detection of

errors in self-contained knowledge and the study of small samples of case studies has been almost impossible. Inconsistencies, however, could mainly be studied via literature overviews, while the impact of artificial reasoning on the theory could hardly be studied. However, in the last twenty years, meta-analysis which is a set of methods for scientific synthesis has been developed; its features may help economists regarding the problems mentioned above. Of course, many gaps remain to be bridged in order to increase the validity of this research tool. But given the difficulties of accumulating knowledge and theorizing, the further development of meta-analysis in economic research could next be a great challenge.

In this paper we present an overview concerning meta-analysis in general, and its features for economics in particular. Besides an introduction into the background of meta-analysis, we consider its features and position with respect to commonly known research objectives: knowledge accumulation and theorizing. Several applications of meta-analysis in economics will be highlighted and insights into current developments will be presented. The structure of this paper is as follows. In Section 2 we consider how economists usually develop their theories. This section will serve as a 'springboard' to Section 3 which will discuss another form of study process which accumulates knowledge to build theories: synthesis. In Section 3 we focus on a specific form of synthesis, namely synthesis via meta-analysis. After an introduction to this new method of scientific research, its features for economic research are highlighted in Section 4. The drawbacks of currently used methods to enhance theorizing will especially serve as a guideline for our presentation. The effects of meta-analysis for empirical research is our topic in Section 5, while Section 6 presents an overview of areas of economic research where practical applications of meta-analysis have been undertaken. The potential of meta-analysis will be indicated in this section as well. Section 7 offers important considerations concerning meta-analysis as well as concluding remarks.

2. Theorizing in Economics: the Old Fashioned Way

In the social sciences the study of phenomena of interest to accumulate knowledge and to theorize are subject to significant problems. However, the main problem is that of real-world complexity. Every real world observation is flawed by the awareness that an unquantifiable set of moderator variables and mutual relationships may determine the genesis and being of the phenomenon observed (see Bal and Nijkarnp, 1998a). Over time, many philosophers have considered this problem and have tried to deal with it.

The observed phenomenon is a result of an interaction between other phenomena and, as a part of the whole, predict the occurrence of other phenomena at some time in the future. In this light, the work of Descartes, Spinoza and Kant has shaped the way scientists deal with this problem of real world complexity since the 17th century. Based on their work in general, modem scientific practioners consider the real world as a constellation of elements (i.e. so-called moderator variables) and their mutual relationships, which can be described in mathematical terms. However, it has been noted that the set of moderator variables and relationships which build a phenomenon (which is the state of the constellation at a certain moment in time) is complex in character. This complex inter-relational structure is hardly open to investigation via a study which includes an obser-

vation and reasoning process. However, the work of Descartes and others has also contributed though the process of analysis which allows for the study of subsets of a phenomenon and reduces problems related to complexity.

As with all other situations, every study process has its pros and cons, and analysis is no exception. Besides the positive aspects of an analysis mentioned above, there are negative aspects directly related to its. But, before we discuss these negative aspects, we must also pay attention to the cost that a case study will induce. Although with analysis a focus is on a subset of the relational structure (i.e. the constellation), this focus is actually an intensive study process (see Yin, 1995). Consequently, these - analytical - case studies are very costly. Existing difficulties during a study process will cause a further rise of research expenses when there is an attempt to overcome them. Apart from the analytical constraints of theory building, the initiation of a case study is mainly limited by financial conditions.

Even when an analytical study process is begun, other difficulties may hinder a study process. For example, in social sciences not all moderator variables can be observed and/or measured directly. The difficulties with respect to the observations mainly stem from the impossibility of isolating the moderator variables as desired, since given the problems concerning measurement they can, largely, be related to moderator variables which are qualitative.

However, practical limitations may also make an analytical study process troublesome or even impossible. In economics, for example, large experiments at the national level to derive insights on existing relationships among moderator variables are usually impossible. In this light, large experiments (such as large swings in the money supply) could have tremendous, possibly uncontrollable impacts on the state of the economy where the experiment is conducted.

It is characteristic of analytical case studies that the results depend on the study conditions under which the study process has taken place. The most common study conditions are the following:

- the period in time considered in the study;
- the geographical position;
- the methodological framework under which the study has taken place;
- the methods used in the study;
- the characteristics of the data set (the time interval considered, the geographical positions, etc).

Generally, the research findings are so-called context-dependent, which means that their validity is conditional on the study conditions. Since case studies are unique in their study conditions, the subsequent study of the research findings cannot be properly undertaken via an analytical concept of thought. An attempt to reach a generalization of research findings is often unsatisfying and lacks integrity.

It is clear then that the difficulties in undertaking case studies in economics with the large sets of qualitative moderator variables together with their high costs will mean that only a small set of case studies will be available. In addition, the available studies might be small and will be subject to context-dependency.

We may conclude from this outline that *although analysis is a very useful concept in scientific research, it reveals some drawbacks which cannot be taken into account within this type of study process.*

3. Synthesis: Another Study Process Available for Economists

In the long history of philosophy the importance of synthesis has often been recognized. The study of previously undertaken research findings may increase the understanding concerning a phenomenon under study. However, for scientists a sound use of synthesis as a method of knowledge accumulation has remained almost impossible until now. Only recently has a systematic study of the features of a synthesis been observed as the result of a desire to develop a more holistic framework and of the will to overcome the shortcomings of the analytical study processes. This rapidly growing attention towards synthesis is largely caused by available research methods which enable this. In this section we take a closer look at recent developments concerning synthesising.

As a concept of thought synthesis is not new. The usefulness of a consideration of elements of knowledge concerning a certain subject in a broader perspective has been recognized and treated as being complementary to partial investigations. In philosophy, analysis is considered as the study of properties of a phenomenon, while a synthesis is to be treated as the composition of properties (see Glymour, 1992). Over time many philosophers have recognized that the study of previously obtained knowledge about a phenomenon may improve our understanding of it. Hence, combining all pieces of knowledge may yield new insights about a subject under study. In fact, in scientific research this means that through a synthesis a certain set of analytical studies is considered in an integral way at a certain moment in time. The reason to study the research findings on a certain (part of a) phenomenon in a synthesis seems straightforward while the Cartesian method analyses a specific part of a real world phenomenon. As a consequence, only a proper subset of the relational structure of the constellation which generates the phenomenon observed is the subject of study (see Bal and Nijkamp, 1998a). Hence, an analytical study process abstract for an non-empty set of moderator variables which help 'explaining' the being of a phenomenon observed. However, the complement of the subset considered contains knowledge that remains unscrutinised in the analysis. According to Bal and Nijkamp (1998a) it is unlikely that all studies concerning a certain phenomenon are identical. Besides a large overlap, significant differences among independent studies included in a well-defined collection of studies will be found. Although initiated studies consider a particular topic, the methods applied, the set of assumptions imposed as well as the data sets used will not be equal among the research processes. Hence the study conditions differ per study undertaken, and will be reflected in the study results. In this light, the study conditions embody elements of knowledge which cannot be distilled via analytical study processes. Only a study of the research findings of case studies concerning a certain phenomenon will make this possible. Thus, bringing together studies followed by an inte-

grated investigation will generate knowledge that cannot be covered in merely an analytical examination of one study question. However, the knowledge obtained will depend on the differences in study conditions among the collection of research findings processed in a synthesis. This leads to the following statement.

A synthesis may generate better insights into the phenomenon under study. The obtained additional knowledge stems from the causal/correlated relationships which cannot be detected via a single case study. This additional knowledge will simplify theorizing and will, later, affect the body of knowledge - i.e. the collection of theories - in a positive way.

Although synthesis as a concept is not new, compared to analysis its use remained minimal. There may be several reasons for this restricted applicability. First, there is the human beings' limitation in managing large sets of pieces of knowledge. Without the assistance of equipment large sets of knowledge cannot be handled. The voluminous materials require the use of computer memory, capacity and speed. Second, the pieces of knowledge may be difficult to study given their incompatibility in format. For example, different styles of presentation of research findings, the (mixed) use of qualitative and quantitative variables as well as conflicting outcomes can make it such that the pieces of knowledge are not easily studied in an integrated way through synthesis. This means that new insights are not inferential via simple argumentation. Hence, in this situation methods used to manage and study a set of research findings are allowed for synthesis. For many centuries proper methods of overcoming these problems underlying a synthesis were not available. Therefore, syntheses in scientific research have mainly been undertaken on a small scale, but the importance of synthesising in the field of economics is known. Numerous accounts in *the Journal of Economic Literature* and *the Journal of Economic Surveys* have indicated this.

Up to now the main method available for a synthesis of research findings in economic research has been the literature review. As a method of research it is well-developed (see Cooper, 1989). According to Van den Bergh et al. (1997), surveys have tended to report findings in tabular or 'pictorial' fashion with verbal comment and a discussion of strengths and weaknesses of each study. Although useful, this study which is qualitative in character, omits a full inclusion of many quantitative aspects of the individual studies. It can neither fully account for the difficulties underlying the application of synthesis, such as incompatibility of pieces of knowledge.

In 1976 Glass introduced the then new study of meta-analysis. Originally, this study approach, which finds its origin in psychology, aimed to examine a well-defined collection of experiments in an integral way by using statistical methods. This study process has evolved towards a broader field of application. Meta-analysis has also found its way to economics, where an increasing number of studies are available. Before we present a survey of the current-state-of-the-art of meta-analysis in economic research a brief introduction of meta-analysis as a method of study is given here.

In the literature many definitions concerning meta-analysis have been presented thus far. However, in the light of the recent developments (Bal and Nijkamp, 1998a; 1998b; Button and Nijkarnp, 1998; Hogenraad, 1989; Slowinski, 1993; Munda et al., 1993) a

more precise definition can be offered. In our view we consider me&analysis as *a scientific investigation of a well-defined collection of previously presented individual studies concerning a certain subject, in which (mainly) quantitative methods are applied which are able to test and assess qualitative as well as quantitative knowledge in order to obtain a study of a well-defined collection of available material with the aim to first gain more insights into the chosen phenomenon under study and second, to end up with a synthesis.*

As we have indicated, syntheses have been difficult to undertake in the past. In our opinion, modem meta-analysis is able to cover this problem to a large extent. Given our definition of meta-analysis, we consider that meta-analysis is a specific form of synthesis. To be more precise, meta-analysis is an integrated study of analytical research findings in a rigorous (mainly quantitative, but in any case measurable) way. In this light, as an "analysis of analyses" (Glass, 1976) meta-analysis seems to be a proper name to describe a process of measurable synthesis. With our definition in mind it is understood that *any synthesis undertaken via measurable methods can be classified as meta-analytical.*

Altogether, meta-analysis studies a well-defined collection of (analytical) research findings in a rigorous way to derive more insights into a phenomenon under study. To undertake this task, various quantitative methods are available for this form of synthesis. These methods can be distinguished into two classes:

- statistical methods (me&regression, etc.);
- soft modelling methods (fuzzy set methods, etc.).

Glass (1976) introduced the name meta-analysis to typify a set of quantitative methods meant to synthesise psychological experiments in a rigorous way. These methods were well-known statistical methods and were adapted whenever required. In Glass et al. (1981), Hunter and Schmidt (1990) and Hedges and Olkin (1985) the methods applicable for a meta-analysis are presented. For example, meta-regression is a method and belongs to this class of meta-analytical methods which is statistical in origin. However, it is less known that non-statistical methods can also be applied to achieve a rigorous synthesis of research findings. These so-called soft modelling techniques which are themselves quantitative in character and are also able to combine research findings in an integrated way. Examples are rough set theory (Pawlak, 1982; Pawlak and Slowinski, 1993), fuzzy set theory (Munda, 1993) and content analysis (Hogenraad, 1989).

In conclusion, *a rigorous study of research findings (i.e. a quantitative synthesis via meta-analytical methods) can be established by means of statistical and non-statistical quantitative methods.*

The use of meta-analysis will affect the process of theorising, and ultimately the body of knowledge concerning economic phenomena. Even the crucial *ceteris paribus* clause for economic research may then be considered in a new context (see Bal and Nijkarnp, 1999). The inductive argumentation in order to explain unexplored cases - i.e. value transfer (also known as benefit transfer) in empirical applications - seems to be positively affected when meta-analysis is used (see Bal and Nijkamp 1998a; Kirchhoff, 1999). Meta-analysis may show even more positive effects in economic research in the future than it has already done.

4. The Features of Meta-analysis in Economic Research

In the previous section we have considered synthesising as a study process available for scientists which is complementary to the commonly used scientific analysis. As we have indicated at the beginning of this paper, economists face certain difficulties when undertaking case studies of economic phenomena. Compared to the natural sciences which rely to a larger extent on well-controlled experiments, economics has a serious disadvantage not only when it comes to case studies but also for synthesising, as these case studies form the basis for such a study process. At first glance, there seems to be a weaker basis for a synthesis in economics. However, as we will show in this section, this need not be true.

As we have made clear in Section 2, many cases are not suitable for case study research. Various difficulties have been pin-pointed with respect to case studies, such as the real world complexity caused by the enormous set of moderator variables and the mutual relationships which makes an observation process and an analysis troublesome, and financial constraints which imply a limitation with respect to the scale and the frequency of studies undertaken.

The process of theory building is also subject to several problems, such as:

- the complexity of the relational structure which makes a reconstruction of the relational structure of the constellation underlying the phenomena at hand difficult;
- incompatibility of research findings due to differences among study conditions and scientific reporting;
- the lack of methods in order to process the research findings.

Especially due to financial constraints and, in various cases, the impossibility of initiating a case study, economics is more severely affected by incompatibility problems during theorising than, for example, the natural sciences. In general, the volume of empirical studies available for theorising in economics is limited. Inevitably, the format of the studies undertaken might be diverse in character. Not only may they differ in the methods applied to study (a certain aspect of) a phenomenon, they also consider different geographical aspects, focus on different periods in time, are undertaken at different moments in time, etc. As a consequence of the differences in study conditions, the set of studies available for a certain phenomenon could be very small in many cases. The implications are straightforward. Since the phenomenon is studied via a small set of studies, it is highly likely that not all aspects have been studied properly, given the complexity of the real-world phenomena. Together with the different approaches chosen to study a certain phenomenon, there is a fair chance that inconsistencies among research findings will appear.

There is another source leading to inconsistencies within the accumulated knowledge base. When empirical studies cannot be conducted as required, another source for accumulating knowledge will be sought: a formal study of economics. Through modelling and the variation of assumptions and conditions, a logical argumentation process may be initiated in order to move one step further. However, the obtained knowledge is self-contained knowledge which is not necessarily empirically sound. But on the level of theorising the use of models will have an impact. Since economists have a rather limited ability

to undertake experiments, the collection of research findings will turn out to be fragmented. For an extensive theory building process this is a major problem. As a consequence, theoretical models (partly based on previously undertaken empirical research findings) have been built to permit argumentation towards an economic theory. However, since the use of theoretical models and the required imposition of assumptions induces the generation of self-contained knowledge, the empirical validity of the obtained theories is not guaranteed ***a priori.***

Therefore, in economics the body of knowledge can be seen as a patchwork of knowledge obtained through empirical studies and self-contained knowledge. In this light, it is clear that an (empirical) validity test on the body of knowledge is almost impossible. Two uncertainties will normally accompany a test. First, empirical studies are subject to the induction problem which implies that a generalization is made from a few sample cases to all cases. Secondly, the knowledge stemming from formal approaches may not be empirically valid. As a consequence, existing inconsistencies among research findings are difficult to sort out via an analysis, while independent studies may generate unexplainable conflicting outcomes of a certain economic phenomenon.

The first step in overcoming these difficulties is to study the set of independent studies more closely in order to:

- derive more knowledge from the set of case studies (which has the interesting feature that it increases the efficiency of scientific research at the same moment in time) ;
- trace the reasons underlying the inconsistencies among research findings. An integrated study of the set of previously undertaken studies is a necessary condition. In this light, in fact a synthesis of studies which are analytical in character is undertaken.

A synthesis may lead to an improvement of the theory of a certain phenomenon under study, and ultimately to an improved body of knowledge in economics. A study process based on a synthesis can generate greater insights into the phenomenon under study and more transparency can be obtained into the causes leading to the presence of conflicting results. Thus, the impacts of conflicting research findings can be tackled directly by a meta-analysis. This method of study will also reduce the level of subjectivity among the body of knowledge.

Thus far we have discussed meta-analysis on a rather abstract level: a collection of research findings forms the input for a study process which is meant to reach a synthesis by means of a set of quantitative methods. This set of quantitative methods, typified as meta-analytical methods, can be subdivided into different categories based on their characteristics of operation. This classification shows how meta-analysis functions within a collection of previous studies. According to Van den Bergh et al. (1997), the following categories can be identified:

1 summarising over a collection of similar studies the relationships, indicators and so on:
2 averaging, possibly using weights, for collections of values obtained in similar studies;

3 comparing, evaluating and ranking studies on the basis of well-defined criteria or goal functions;
4 aggregating studies, by taking complementary results or perspectives;
5 apprehending common elements in different studies;
6 comparing different methods applied to similar questions;
7 tracing factors responsible for differing results across similar studies.

Except for categories 3 and 6, conventional statistical methods serve as basis for the various meta-analytical methods developed. For an extensive introduction into statistical meta-analytical methods we refer to, for example, Hunter and Schmidt (1990), Hedges and Olkin (1985) and Wolf (1986). The research findings of the collection of studies must be compatible with the meta-analytical methods that are statistical in character. Under certain circumstances, these statistical methods require a level of information which cannot be fulfilled. For example, the lack of detailed information reported from the research findings or perhaps qualitative variables may make the use of statistical methods for synthesising impossible.

Among the set of non-statistical meta-analytical methods, we may count meta-multiple criteria analysis (MMCA) and rough set theory. According to Van den Bergh et al. (1997), MMCA may be used for meta-analytical studies with respect to categories 3 and 6. In fact, compared to multiple criteria analysis, MMCA considers research findings within the study which makes it possible to compare, evaluate and rank research findings and the performance of different methods. For an application of MMCA, we refer to Janssen (1992), Keeney and Raiffa (1976), Rietveld (1980) and Zeleny (1982).

According to Slowinski and Stefanowski (1994), rough set theory is applicable in cases with ambiguous data and when ordinary statistical methods cannot be applied. In general, the non-statistical rough set theory can be applied to study multi-attribute preference systems in a context with uncertainty, i.e. inconsistencies among research findings. Notwithstanding the differences between fuzzy set theory and rough set theory (see Dubois and Prada, 1992), fuzzy set theory can be applied under the same circumstances (see, for example, Munda, 1993).

In conclusion, *meta-analysis is able to reduce the impacts of many analytical drawbacks by the use of statistical and non-statistical methods which are able to average, compare, evaluate, summarise and rank research findings. Hence, it is able to study the influences of study conditions on the outcomes of the studies considered and make an integrated study of a large set of research findings manageable.*

5. Meta-analysis in Economic Research

In the 1970s meta-analysis emerged in the field of psychology (see Glass, 1976). Well-controlled experiments became subject of study in a quantitative synthesis. An 'early adopter' of this new method of study was marketing research, which is not surprising given the fact that in psychology a significant number of studies on consumer behaviour are undertaken (see Bettman 1986; Cohen and Chakravarti, 1990). So, marketing as a field of economic research still has the lead when it comes to the application of meta-

analysis in economics. However, in other fields of economic research a growing interest in meta-analytical research can be observed; especially in environmental economics (for an overview, see Van den Bergh et al., 1997) and transport economics (e.g. Button, 1995; Button and Kerr, 1996; Schipper, 1996), an increasing number of meta-analytical studies have recently become available.

Economics studies a rich variety of economic research issues. In the light of the observations made in previous sections, the relevance of meta-analysis for most fields of economic research is apparent. If we limit ourselves to environmental economics and transport economics, meta-analysis may be seen to have been applied in several empirical studies. According to Van den Bergh et al. (1997), meta-analysis may be useful when studying:

- noise nuisance problems;
- traffic accident levels;
- traffic congestion;
- recreational amenities;
- visual intrusion;
- watercourse pollution;
- global warming issues;
- materials-product systems and industrial metabolism.

However, meta-analysis can be applied in several other areas of economic research, such as labour markets (see Hackett, 1990; Scott and Taylor, 1985; Steel and Ovaille, 1984). In industrial organisation meta-analytical studies have also been undertaken. For example, a meta-analytical study concerning the X-efficiency has been undertaken by Button and Weyman-Jones (1994), and a study of the link between fiscal incentives on micro- and meso-economic performance has been conducted via this method of scientific research by Phillips and Goss (1995). With respect to the growing body of studies in these disciplines of economic research, marketing remains the main user of meta-analytical methods in economic research. Therefore, we will briefly discuss the use of meta-analysis in marketing before proceeding to our survey on environmental and transport economic studies.

The empirical character of marketing and the interest in human behaviour, particularly the conduct of the consumer from psychological standpoints, has led to an early adoption of meta-analysis in research initiatives. Beside the use of meta-analysis to 'review' earlier studies (see, for example, Brown and Stayman, 1992), causal analysis as a specific application of meta-analysis has particularly attracted much attention. The availability of the software package LISREL (see Jöreskog and Sörbom, 1989; 1993) plays an important role in this context. According to Homburg and Baumgartner (1995), causal analysis is mainly used in order to find confirmation of theories rather than to discover new model specifications given the available data. With these insights theories can be improved.

The recognition that meta-analysis may also have important features for other fields of economic research has led to the popularity of meta-analytical studies in, for example, transport economics and environmental economics (for an overview, see Van den Bergh et al., 1997). A growing body of studies is now available and the advantages of meta-analyti-

cal study processes have become more evident. In the remainder of this section we will discuss the advantages of meta-analysis more carefully.

In their paper Button and Kerr (1996) searched for the potential of meta-analysis as a method of research. They studied the impacts of traffic restraint policies in urban areas via meta-regression. Besides the commonly known features of meta-analysis (such as cost saving when compared with case studies, the possibility of assessing a mix of quantitative- and qualitative data, etc.), Button and Kerr recognized that meta-analysis is a promising tool in decision-making processes at the policy level. In fact, with meta-analysis it is possible to go one step further. Besides the significant level of qualitative data which can be assessed, the different objectives of the actors - which often conflict - can be analysed simultaneously (see, in this context, Munda et al., 1993; Slowinski, 1993).

Another interesting meta-analytical study comes from Espey (1996). By using meta-analysis, Espey (1996) successfully studied a collection of case studies on gasoline demand which showed large discrepancies in study conditions. Normally, in this situation a comparative study is practically impossible. However, through a meta-analysis, Espey (1996) was able to analyse how the research findings were affected by the study conditions. *In concreto*, *the* price elasticity for gasoline was studied, given the differences in data sets used (monthly and quarterly data versus yearly data) as well as the applied methods (static and dynamic models).

Finally, it is interesting to consider the study of Schipper (1996) on the valuation of aircraft noise. Not only could Schipper confirm the research findings of Nelson (1980) in a rigorous way by means of a meta-analysis, the author was also able to test the collection of studies on the possible existence of a publication bias (Berlin et al., 1989; Dalhuisen and Florax, 1999), as it has been developed by Card and Krueger (1995).

Given the above overview concerning the use of meta-analysis in economics, we may conclude that *this method of scientijic research shows a great potential in order to increase the body of knowledge about economic phenomena via an improvement of built theories. It simultaneously induces a rise in efficiency of research endeavors due to the further exploration of existing scientijic material and the possibility of achieving an improvement of the process of new research initiatives.*

6. Meta-analysis: Important Considerations

As the previous sections have tried to make clear, meta-analysis has a great potential in social sciences in general, and economics in particular, when it comes to knowledge accumulation and theorising. However, like every other method of research, meta-analysis has its limitations. In this section we discuss those effects which may reduce the performance of meta-analysis as a method of study.

As with every other study process, a meta-analysis is based on a research plan. In general, the way the research process is deployed will significantly affect the study outcome of the synthesis. The quality of this study process will affect the performance of the study. In fact, from a logical standpoint-of-view, the decision to focus on a particular

group of studies and/or a subset of meta-analytical methods will have implications for the results obtained. In this light, in practice the choice to include or exclude case studies is an important factor. It is clear that the role of the researcher might be crucial here when we realise that this phase of the research process is most sensitive to subjective elements. Various reasons may exist for leaving studies out of the synthesis. For example, Button and Weyman-Jones (1994) limit themselves to those studies which pass a somewhat arbitrary statistical cut-off point, Mitra et al. (1992) have excluded non-published studies in their study while Nelson (1980) has chosen only, in his opinion, the best studies. However, also other factors may affect the selection of case studies. For example, the lack of previously undertaken case studies may significantly obstruct the study process.

However, other difficulties also must be considered when the results of a synthesis via a meta-analysis are considered. The studies collected may be subject to several pitfalls which are usually difficult to detect and eliminate. First, the collected studies are not necessarily independent from each other. New research is, to some extent, based on previous studies. This is especially the case when case studies cannot be undertaken in an experimental setting. Secondly, the studies might be subject to publication biases. It is widely believed that the available literature is biased in favour of positive results. The study of Greenwald (1975) seems to support this belief. The importance of eliminating this type of bias before the studies are considered via a meta-analysis is obvious (see Glass et al., 198 1). However, the bias due to the report of positive results among the collection of studies can be eased to some degree when prior to a meta-analysis a statisticai method is applied to detect the existence of such a bias (see Dear and Begg, 1992 and Berlin et al., 1989). Third, the quality of the case studies will differ with the quality of the distinct studies included in the collection of studies. However, the imposition of weights is possible, but will introduce a subjective element into the study which will have its own implications on the study outcome. Fourth, although the studies fulfil the selection criteria, they are not necessarily in a standardised format of presentation nor are they mutually compatible with each other. For example, in their study, Smith and Kaoru (1990) were forced to consider a small set of studies due to the different formats in which the research findings were presented. It is clear that the overall performance of meta-analysis will be reduced when a standardisation among the selected studies is undertaken - as a result of the undesired ignorance of relevant information or when the research findings must be translated into a format which is compatible with the meta-analytical method. In this light, special qualitative aspects considered in case studies form the main source of the compatibility problem. A translation via, for example, fuzzy set theory is often required (see, Kacprzyk, 1978).

From this section we may conclude that *although meta-analysis is able to reduce the level of subjectivity among research findings due to the direct access of a collection of studies, it cannot completely remove it. A careful consideration of all aspects which may affect the performance of meta-analysis in a negative way must therefore be attended to.*

7. Conclusion

In our paper we have presented an overview of the background, current state-of-the-art and the potential of meta-analysis in economic research. It can be observed that meta-

analysis is a relatively new method of study which has gained rapid ground in empirical economics. This is not surprising given the fact that this method is the only available tool in which research findings can be assessed rigorously and which results in a synthesis. To initiate a comparative study of research findings with a view to a synthesis cannot be undertaken by any other method of study other than meta-analysis in scientific research. In fact, by means of meta-analysis inconsistencies among analytical research findings can be explained and the impact of the study conditions on the research findings can be analysed, by a quantitative analysis.

In our view, meta-analysis as a fairly new scientific method will have a significant effect on the practice of economic research. Until the introduction of meta-analysis, a comparative study of research findings with the possibility to reach **a** synthesis in a rigorous way was not possible. In fact, a survey only allows a quantitative study of research findings, and this is problematic when the study conditions under which each case study is undertaken differ significantly, or when the research findings are published in different formats. However, in our opinion, a survey and meta-analysis can be considered as complementary to each other.

A further boost in research through the tool of meta-analysis may thus be expected in the future. Especially interesting will be the development of meta-analytical methods for multi-objective decision-making processes at the policy level. It is clear that an effective assessment methodology for dealing with complex optimization problems is needed, since cost-benefit analysis shows significant drawbacks in many real-world applications. As we have indicated, meta-analysis certainly has the potential to analyse decision-making processes at the policy level. Finally, important in several applications, meta-analysis will also be able to study the available research findings on publication biases.

References

Bal, F. and Nijkamp, P. (1998a) "In Search of Valid Results in a Complex Economic Environment: the Potential of Meta-analysis and Value Transfer", ***Tinbergen Institute Discussion Paper TI 98-005/3***, Tinbergen Institute, Amsterdam.

Bal, F. and Nijkamp, P. (1998b) "Winners and Losers in Spatial Duopoly Markets; the Relevance of a Value Transfer Approach", ***Tinbergen Institute Discussion Paper TI 98-004/3***, Tinbergen Institute, Amsterdam.

Bal, F. and Nijkamp, P. (1999) "The Ceteris Paribus Clause in the Context of Meta-analysis and Value Transfer", in: ***Comparative Environmental Economic Assessment: Meta-analysis and Benefit Transfer,*** R.J.G.M. Florax, P. Nijkamp and K. Willis (eds.), forthcoming.

Bateman, I. J., Brainard, J. S . and Lovett, A. A. (1995) "Modelling Woodland Recreation Demand Using Geographical Information Systems: a Benefit Transfer Study ", *CSERGE* ***Working Paper GEC*** 95-06, University of East Anglia, Norwich.

Bergh, J.C.J.M. van den, Button, K.J., Nijkamp, P. and Pepping, G.C. (1997) *Meta-analysis in Environmental Economics,* Kluwer Academic Publishers, Dordrecht.

Berlin, J.E., Begg, C.B. and Louis, T.A. (1989) "An Assessment of Publication Bias Using a Sample of Published Clinical Trials", *Journal of the American Statistical Association,* vol. 84, 406, pp. 381-392.

Bettman, J.R. (1986) "Consumer Psychology", in: *Annual Review of Psychology,* M.R. Rosenschweig and L.W. Porter (eds.), vol. 37, pp. 257-290.

Bos, E.J. and van den Bergh, J.C.J.M. (1998) "Economic Evaluation, Land/Water Use, and Sustainable Nature Conservation of 'De Vechtstreek' Wetlands", *Tinbergen Institute Discussion Paper TI 98-036/3*, Tinbergen Institute, Amsterdam.

Brown, S . P. and Stayman, D. M. (1992) "Antecedents and Consequences of Attitude Toward the Ad: a Meta-analysis", *Journal of Consumer Research, vol.* 19, pp. 34-5 1.

Button, K.J. (1995) "What can Meta-analysis Tell Us about the Implications of Transport? ", *Regional Studies, vol. 29,* pp. 507-5 17.

Button, K.J. and Kerr, J. (1996) "Effectiveness of Traffic Restraint Policies: a Simple Meta-regression Analysis", *International Journal of Transport Economics, vol. 23,* pp. 214-225.

Button, K.J. and Nijkamp, P. (1998) "The Reality of Using 'Benefit Transfers' in Transport Decision-Making", *Tinbergen Institute Discussion Paper TI 98-062/3*, Tinbergen Institute, Amsterdam.

Button, K. J. and Weyman-Jones, T. G. (1994) "X-efficiency and Technical Efficiency", *Public Choice,* vol. 80, pp. 83-104.

Card, D. and Krueger, A. (1995) "Time-series Minimum-wage Studies: a Meta-analysis", *American Economic Review,* vol. 85, 2, pp. 238-243.

Cohen, J.B. and Chakravarti, D. (1990) "Consumer Psychology", in: *Annual Review of Psychology,* M.R. Rosenschweig and L.W. Porter (eds.), vol. 41, pp. 243-288.

Cooper, H .M. *(* 1989) *Integrating Research: a Guide for Literature Reviews,* Sage, Newbury Park.

Dalhuisen, J. and Florax, R.J.G.M. (1999) "Self Selection Bias and Non-discrete Representation in Environmental Meta-analyses" , in: *Comparative Environmental Economic Assessment: Meta-analysis and Benefit Transfer,* R. J. G. M. Florax, P. Nijkamp and K. Willis (eds.), forthcoming.

Dear, K. B. G., Begg, C .B. (1992) "An Approach for Assessing Publication Bias Prior to Performing a Meta-analysis" , *Statistical Science,* vol. 7, 2, pp. 327-245.

Dubois, D. and Prada, H. (1992) "Putting Rough Sets and Fuzzy Sets Together", in: ***Intelligent Decision Support,*** R. Slowinski (ed.), Kluwer, Dordrecht, pp. 203-232.

Dwyer, J.F., Kelly, J.R. and Bowes, M.D. (1977) "Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development", ***Water Resources Center Research Report*** *128*, University of Illinois, Urbana-Champaign.

Espey, M. (1996) "Explaining the Variation in Elasticity Estimates of Gasoline Demand in the United States: a Me&analysis", *The* ***Energy Journal,*** vol. 17, 3, pp. 49-60.

Glass, G.V. (1976) "Primary, Secondary and Meta-analysis of Research", ***Educational Researcher,*** vol. 5, pp. 3-8.

Glass, G.V., McGraw, B. and Smith, M.L. (1981) ***Meta-analysis in Social Research,*** Sage, Beverly Hills.

Glymour, ***C. (1992)*** *Thinking* ***Things Through,*** The MIT Press, Cambridge.

Greenwald, A.G. (1975) "Consequences of Prejudice Against the Null Hypothesis", ***Psychological Bulletin,*** vol. 82, 1, pp. l-20.

Hackett, R.D. (1990) "Age, Tenure and Unemployment Absenteeism", ***Human Relations,*** vol. 43, pp. 601-619.

Hedges, L.V. and Olkin, ***I.*** (1985) ***Statistical Methods for Meta-analysis,*** Academic Press, Orlando.

Hogenraad, R. (1989) "The Rhetoric Texture of ***an*** Ad", in: ***Consumer Behaviour and Strategic Marketing: Anything*** New?, *ISADA*, Palermo.

Homburg, C. and Baumgartner, H. (1995) "Die Kausalanalyse als Instrument der Marketingforschung : eine Bestandsaufnahme" , *Zeitschrift für Betriebswirtschaft*, ***65,*** 10, pp. 1091-1108.

Hunter, J.E. and Schmidt, F.L. (1990) ***Methods of Meta-analysis,*** Sage Publications, London.

Janssen, R. (1992) ***Multi-objective Decision Support for Environmental Management,*** Kluwer , Dordrecht .

Joreskog and Sörbom (1989) ***LISREL 7: A Guide to the Program and Applications,*** 2nd ed., SPSS, Chicago.

Joreskog and Sörbom (1993) ***LISREL 8: User's Reference Guide,*** Scientific Software International, Chicago.

Kacprzyk, J. (1978) "Decision-making in a Fuzzy Environment with Fuzzy termination Time", ***Fuzzy Sets and Systems,*** vol. 1, 3, pp. 169-181.

Keeney, R.L. and Raiffa (1976) *Decisions with Multiple Objectives: Preferences and Value Trade-offs*, Wiley, New York.

Kirchhoff, S. (1999) "Benefit Transfer Function versus Meta-analysis as Policy-Making Tools: a Comparison", in: *Comparative Environmental Economic Assessment: Meta-analysis and Benefit Transfer,* R.J.G.M. Florax, P. Nijkamp and K. Willis (eds.), forthcoming.

Mitra, A., Jenkins, J.G. and Gupta, N.A. (1992) "A Meta-analytic Review of the Relationship between Absence and Turnover", *Journal of Applied Psychology, vol. 6,* pp. 879-889.

Munda, *G. (1993) Fuzzy Information in Multicriteria Environmental Evaluation Models,* Ph.D. Dissertation, Free University of Amsterdam.

Munda, G., Nijkamp, P. and Rietveld, P. (1993) "Information Precision and Evaluation Models", in: *Efficiency in the Public Sector,* E. Giardina and A. Williams (eds.), Edward Elgar, Aldershot, pp. 121-142.

Nelson, J.P. (1980) "Airports and Property Values: a Survey of Recent Evidence", *Journal of Transport Economics and Policy,* vol. 19, pp. 37-52.

Parsons, G.R. and Kealy , M. J. (1994) "Benefits Transfer in a Random Utility Model of Recreation", *Water Resources Research,* vol. 30, 8, pp. 2477-2484.

Pawlak, Z. (1982) "Rough Sets", *International Journal of Information and Computer Sciences,* vol. 11, 5, pp. 341-356.

Pawlak, Z. and Slowinski, R. (1993) "Decision Analysis Using Rough Sets", *International Transactions in Operations Research,* vol *1.*

Phillips, J.M. and Goss, E.P. (1995) "The Effect of State and Local Taxes on Economic Development: a Meta-analysis", *Southern Economic Journal,* vol. 62, pp. 320-333.

Rietveld, P. (1980) *Multiple Objective Decision Methods in Regional Planning,* North-Holland, Amsterdam.

Schipper, Y. J. J. (1996) "On the Valuation of Aircraft Noise: a Meta-analysis", Paper presented at the 36th Congress of the European Regional Science Association, Zurich.

Scott, D.K. and Taylor, G.S. (1995) "An Examination of Conflicting Findings on the Relationship Between Job Satisfaction and Absenteeism: a Meta-analysis", *Academy of Management Journal,* vol. 28, pp. 599-612.

Slowinski, R. (1993) "Rough Set Learning of Preferential Attitudes for Multi-criteria Decision-making", in: *Methodologies for Intelligent Systems, Lecture Notes in Artificial Intelligence,* J. Komorowski and Z.W. Ras (eds.), vol. 689, Springer-Verlag, Berlin.

Slowinski, R. and Stefanowski, J. (1994) *ROUGHDAS Rough Set based DATA Analysis System: Version* 2.0 User's *Guide Book*, Technical University of Poznan.

Smith, V.K. and Kaoru, Y. (1990) "Signals or Noise: Explaining the Variation in Recreational Benefit Estimates", *American Journal of Agricultural Economics*, vol.72, pp. 4 19-433.

Steel, R.P. and Ovaille, (1984) "A Review and Meta-analysis of Research on the Relationship Between Behavioral Intentions and Employee Turnover", *Journal of Applied Psychology*, vol. 69, pp. 673-686.

Wolf, F. (1986) *Meta-analysis: Quantitative Methods for Research Synthesis*, Sage, Beverly Hills.

Yin, R. (1995) *Case Study Research*, Sage, New York.

Zeleny, M. (1982) *Multiple Criteria Decision Making*, McGraw Hill, New York.